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Evaluating Organisational Designs in the Forestry Wood Supply Chain to Support Forest Owners' Cooperations

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In the coming decades European forest-based industries could face a lack of wood as raw material because of low mobilisation of the net annual increment, even though there is a huge amount of green inventory in European forests. The main obstacle to systematic exploitation of the wood inventories is small-scale ownership. Forest Owner Cooperations (FOCs) try to overcome this by jointly undertaking activities including harvesting, transporting, marketing and accounting. In this paper, the concept of business-process engineering is applied to FOCs in Austria and Germany. Using case studies, productivity is compared for three business process models that are implemented by FOCs. Because of the lack of consistent data about time spent by various process owners for different processes, interactions are used as an indicator of process efficiency of the alternative business process models. The main contribution of the paper is to provide a guideline to compare different FOC business process models with respect to the interactions of participants. Reducing the interaction (or transaction) cost of timber supply is one way to improve the availability of wood as a raw material. It can be shown that the proposed dividend model requires less process interactions than other models examined in this paper.

Keywords: process analysis, business process improvement, interactions between participants, dividend model

INTRODUCTION AND PROBLEM DESCRIPTION

European forest-based industries could face a lack of wood as raw material in the coming decades because of low mobilisation of the net annual increment (de Galembert 2003). Mobilisation means creating an accessible inventory for the mills from the growing forest asset. Companies in the forest products industries expect increasing competition for wood supply in the European Union. The wood and paper industry have a demonstrated increasing future demand for timber that will not be able to be met by small-scale suppliers unless they improve the efficiency of their business processes. Especially in small-scale forests (with an area of less than 200 ha), there is a huge potential for increased timber utilisation. Small-scale forests are defined differently in various countries and the Austrian Forest Inventory (Bundesamt und Forschungszentrum für Wald 2003) indicates harvesting arrears of 74.7 M m^3 in small-scale forests.

Two distinct supply chain types from small-scale forests to the timber processing industry are common. The small-scale forest owner may handle all forest activities including harvest planning, felling and timber haulage himself and sell directly to industry or to a trader. Alternatively, the forest owner may be a member of a Forest Owner Cooperation[1] (FOC), an organisation of forest owners that bundles harvested timber and typically sells to the timber processing industry. Industry buys wood alongside a forest road in order to arrange the transport to the mills. Small-scale forest owners can additionally engage FOC assistance for planning or harvesting activities. These supporting services of FOCs are important to increase timber utilisation. Because of larger supply quantities and lower transaction costs, industry pays FOCs higher prices for timber than it does to single small-scale producers. FOCs handle their processes mostly with part-time employees who have developed a smooth working system of small-scale forest cooperation in common timber sales. Even so, the marketability of wood out of small-scale forests remains a problem because of less than optimal processes inside the FOCs. So the challenge for FOCs is to increase small-scale forest cost-effectiveness.

The situation of low mobilisation and large green inventory is not new. Kar (1974) explained the low rate of timber utilisation in Upper Austria as a symptom of structural disadvantages in small-scale forests. He attributed this low rate to weak market position, lack of forest management knowledge, low volumes supplied per forest owner, low machine utilisation ratio and difficulties in promotion and in gaining the support of public authorities. Most of these problems remain unresolved. Low mobilisation of timber out of small forest stands is also a result of forest owners' lack of time for timber harvesting (Suda and Warkotsch 2002), as well as increasing harvesting costs and ageing owners who are no longer physically able to harvest timber (Bolkesjo and Baardsen 2002). But also new types of forest owners appear who value forest as a place to spend leisure time or to hunt and who do not want to harvest timber (Hogl *et al*. 2003).

The market position of small-scale foresters has improved through FOCs and the higher timber price they can offer their members is the main motivating factor for membership (Grall 2001), followed by the services they offer (Rapp 2000). A number of international examples are to be found in the literature that show the benefits of cooperations among small-scale foresters. For example, for Irish farmers, not having sufficient time to undertake management of a forest themselves is the most common reason for participating in the Farm Partnership Scheme, which is a joint venture between Coillte (the Irish Forestry Board) and farmers. Especially for part-time farmers or farmers with off-farm jobs, this opportunity to utilise their holdings with minimum input of labour is highly attractive (Ni Dhubhain and Kavanagh 2003).

Some of the problems listed above seem still to remain (Rauch 2002), even after forming cooperatives. In the south-east USA, cooperative timber marketing efforts have not been successful, mainly due to the periodic and uneven timber harvest by most forest owners (Sample 1994). Time-consuming consultancies for single small forest owners often results in only a tiny timber supply. Therefore, in Washington State some agencies restrict their harvesting cost-share programs to forest holdings

[1] The term 'cooperation' as used in Europe is equivalent to the term 'cooperative' used for example in the USA and Australia.

of 8 ha or more (Baumgartner *et al*. 2003). The smallest forest area Coillte is considering in the Farm Partnership Scheme is 20 ha, or 8 ha where the area is contiguous to an existing Coillte plantation (Ni Dhubhain and Kavanagh 2003). Effective support measures are also required to reach people owning less than 8 ha of forest (Frank 2000, Rauch 2003).

More and more, people without forest knowledge or experience in forest management are becoming forest owners because of structural changes in society (Hogl *et al*. 2003). Though consultancy activities from public authorities and FOC concepts were created for forest owners who are able and willing to work in their own forest, there are hardly any services provided for these new groups of forest owners (Beck 1997). As well, experience of Austrian foresters both from public authorities and private lobbies reveals that their forestry educational programs reach only forest owners who already actively manage their stands. Similar findings have been presented by Baumgartner *et al*. (2003) in their study on use and effectiveness of Washington State's extension forest stewardship program. Users of this program have larger median land ownership than non-users, and manage their forests more actively for timber production. They suggested that there may be more effective ways to reach non-users through utilisation of existing resources rather than to extend the program with more staffing.

Heinimann (1998, 1999) suggested that new forms of organisations can be developed where small-scale forests of many owners can be merged to forest production units that are jointly managed. Advancement of FOC with further services as well as new models for FOCs is seen as a basis for utilising small-scale forest resources (Leinert 1998, Bamberger 1999, Romer *et al*. 2000, Zielke 2000, Rauch 2001).

Application of business re-engineering methodology reveals high potential for FOCs to utilise better small-scale forest resources. In addition, methods can be identified to support FOCs in developing process efficiency and adapting to various types of forest owners. In this paper, the concept of business-process engineering is applied and current business process models of FOCs for Austria and Germany are described and compared.

ANALYSING WOOD SUPPLY METHODS IN FOREST OWNER COOPERATIONS

Various logistic process designs are adopted by different FOCs, even though they are undertaking the same business activities. Hence, before starting a re-engineering activity it is important to understand the processes and their functions exactly within a FOC. A business process can be understood as a linked and completed series of activities that are required to fulfil an operational task (Staud 2001).

Applied Process Engineering Methodology

Vakola and Rezgui (2000, p. 244) found in their study about methods in Business Process Re-engineering (BPR) that 'It is even more important to understand existing processes before designing new ones'. The aim of modelling the business processes is to adapt processes according to changes in business and technology and to optimise existing procedures (Kühn and Karagiannis 2001). Besides this technical

view, it can be stated that process interactions are building personal relations between process owners.

A business process model represents the logical and timely sequence of activities of a particular value chain. Existing business process models are a basis for re-engineering and can be used to identify possibilities for automation of processes, redundancies and process downtime (McKay and Radnor 1998). Both manual and automated processes can be modelled (Karagiannis *et al.* 2002). Distinctions between these two kinds of processes are made at workflow level where data and software programs for electronic data processing are required. Processes from partners in a particular supply chain are joined together in a business process model showing interfaces and interactions between business partners as well as detailed processes of the enterprise under investigation. Detailed business process models can be derived from the process map.

At the beginning of a BPR project, the actual processes and their functions have to be identified, which involves process analyses to scan and document the main activities of the supply chain (Gudehus 1999). Process analyses are made to reveal the status quo of the wood supply chain between mills and small-scale forestry. First, the process chain must be defined, starting at the mills with the roundwood budget planning and the resulting buying activities, and ending with the financial transactions between mills, FOCs and their members. Investigations in this paper have been concentrated on the order-delivery process, that is, the management of material and information flows between mills and FOCs.

Table 1 presents a list of the supply chain partners. With the help of a standardised interview, the following data were obtained for each forestry-wood industry chain: (1) the strengths and the weaknesses of business processes and organisational structures, (2) the process owners' views of supply chain improvement potential, as well as (3) business processes (including details of the material and information flow) for a each forestry-wood industry chain. To obtain a connected supply chain, a process is defined so that each process has a process-realising event, which triggers the process. The process itself has a dedicated input and output, process owner, interfaces from and to the process, and a process result which is the process-realising event for the following process. In the research reported here, processes of a number of Austrian forest-wood industry chains ranging from small-scale forest to sawmills and paper mills have been analysed to document the current status of their business processes.

To provide a broader data basis to deduce innovative organisational models, additional process analyses were made for FOC Föhrenberg (Federal state of Burgenland, Austria), FOC Fresdorfer Heide (Germany), FOC Dreetzer Heide (Germany) and FOC Brandenburg (Germany).

A variety of methods are available for structuring and modelling business processes. This study uses the ADONIS business process management toolkit 3.6 (described by Junginger *et al.* 2000). Detailed analyses can be made using this toolkit. These analyses contain bottleneck analyses, the number and capacity of required resources, and most likely process paths, as well as considering different frequencies of processes. For modelling processes, two hierarchical echelons are used, namely (i) a process map showing the main processes, and (ii) a detailed business process model. The process map provides an overview and is addressed to top management. The business process model provides detailed information about

each process named in the process model, and is used by process owners and process reengineers (Kühn and Karagiannis 2001). Because of a lack of consistent data about the amount of time various process owners spend for different processes, the number of interactions in the supply chain will be used as indicator of process efficiency. Interactions are considered as reliable indicator because two ore more process owners have to coordinate themselves in order to carry out a process jointly. Therefore, each interaction causes coordination costs.

Table 1. Forestry-wood industry chain partners analysed

FOC	Third party logistics	Forest products industries	
		Sawmills[2]	Paper mills
Hartberg Fürstenfeld Soboth Bruck/Mur Leoben	Konrad (timber harvesting, St) Tesch (carrier, St)	Stora Enso (LA) Mayr-Melnhof-Saurau (St) Mosser (LA) Bichler (St) Kern (St) Leimer (St)	Papierholz Austria (national wood buying syndicate of all paper mills in Austria, St)

Standard Process Map of the Supply Chain, FOC to Mill

Process maps show the process architecture for top management and process owners. They provide an overview of all business processes of a company and define the core processes (Kühn and Karagiannis 2001). In Figure 1, the main processes are arranged according to their frequency and their chronological order. They can be characterised as follows:

Conclude framework contract[3]: Once a year members are asked to announce their planned harvesting activities and the resulting wood volumes. FOC employees make contracts with sawmills and paper mills, based on members' planned wood harvesting activities.

Communicate framework prices and assortments: After contracting, FOC informs members about actual agreed volumes, prices and assortments.
Harvest timber: FOC employees consult members about silviculture and wood harvesting if needed and wood is harvested.

Administer supply licences: Some sawmills and paper mills try to control the wood volume they receive by issuing supply licences valid for a fixed period to their suppliers. Each supplier has to hand out one supply licence to the carrier for each truck load and the carrier has to hand it over at the mill.

[2] LA represents the Federal state of Lower Austria, and 'St' the Federal state of Styria, both of which form part of the Republic of Austria. For companies with several production sites, only the country of the analysed site is named.

[3] The framework contract runs usually for one or half a year and fixes supply volumes for monthly periods. The contract provides for prices to change if market prices rise or decrease by more than an agreed amount.

Organise transport: FOC employee organises timber transport from forest to mill.

Accept shipment: As basis for payment, mill workers measure timber volume and check timber quality at the mill. According to a set of timber quality parameters including taper and knottiness, various log quality categories with different prices paid are used at the mills.

Generate FOC's invoice: At first mills make out an invoice for the whole FOC and then pay four to six weeks after billing for all the timber supplied by the FOC during the invoicing period.

Generate member's invoices: FOCs have to split the overall invoice for FOC wood into invoices for each individual member's wood and according to individual invoices to transfer money to members as well as to periodically control supply volume in terms of agreed quantity and delivery period.

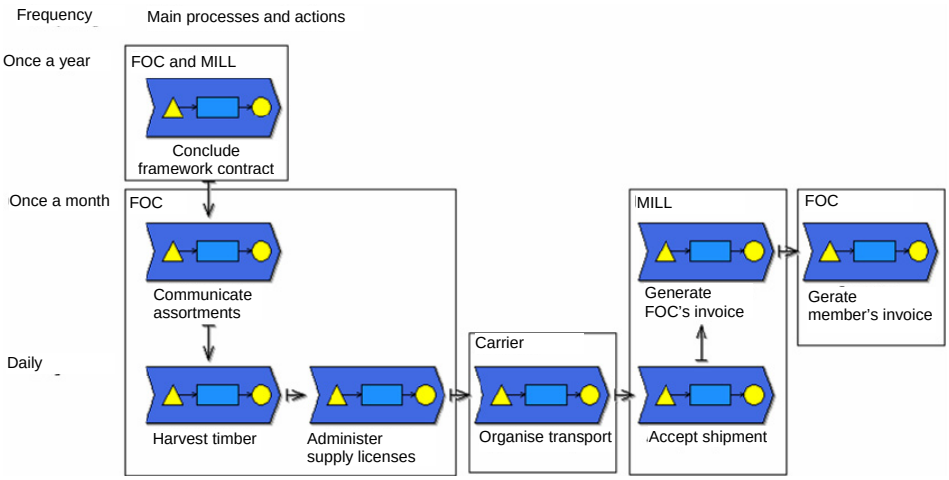

Figure 1. Standard process map of the supply chain, FOC to mill

Case Study: The Actual Styrian FOC Business Process Model

Figure 2 and Figure 3 together present a detailed business process model for the case study FOC Leoben in Styria (Austria), including both planning activities and operations. FOC Leoben is one of Austria's biggest FOCs offering various services such as the use of their own cable crane harvesting unit or planning thinning operations with harvesters. This is an 'actual' business process model in that it has been implemented and can be observed. The model includes the processes and interfaces of the business partners of sawmills, paper mills and carriers.

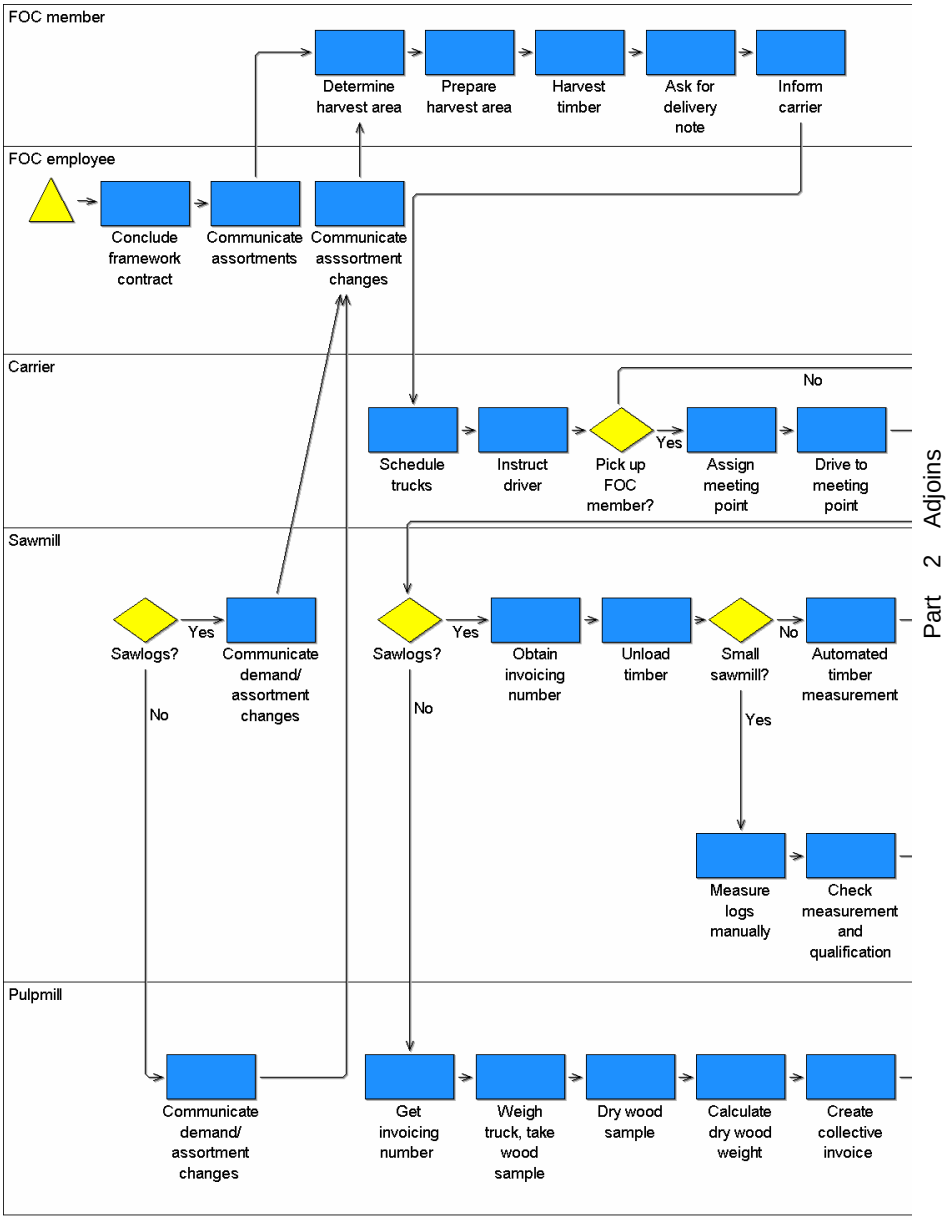

Figure 2. The actual business process model for FOC Leoben (Part 1)

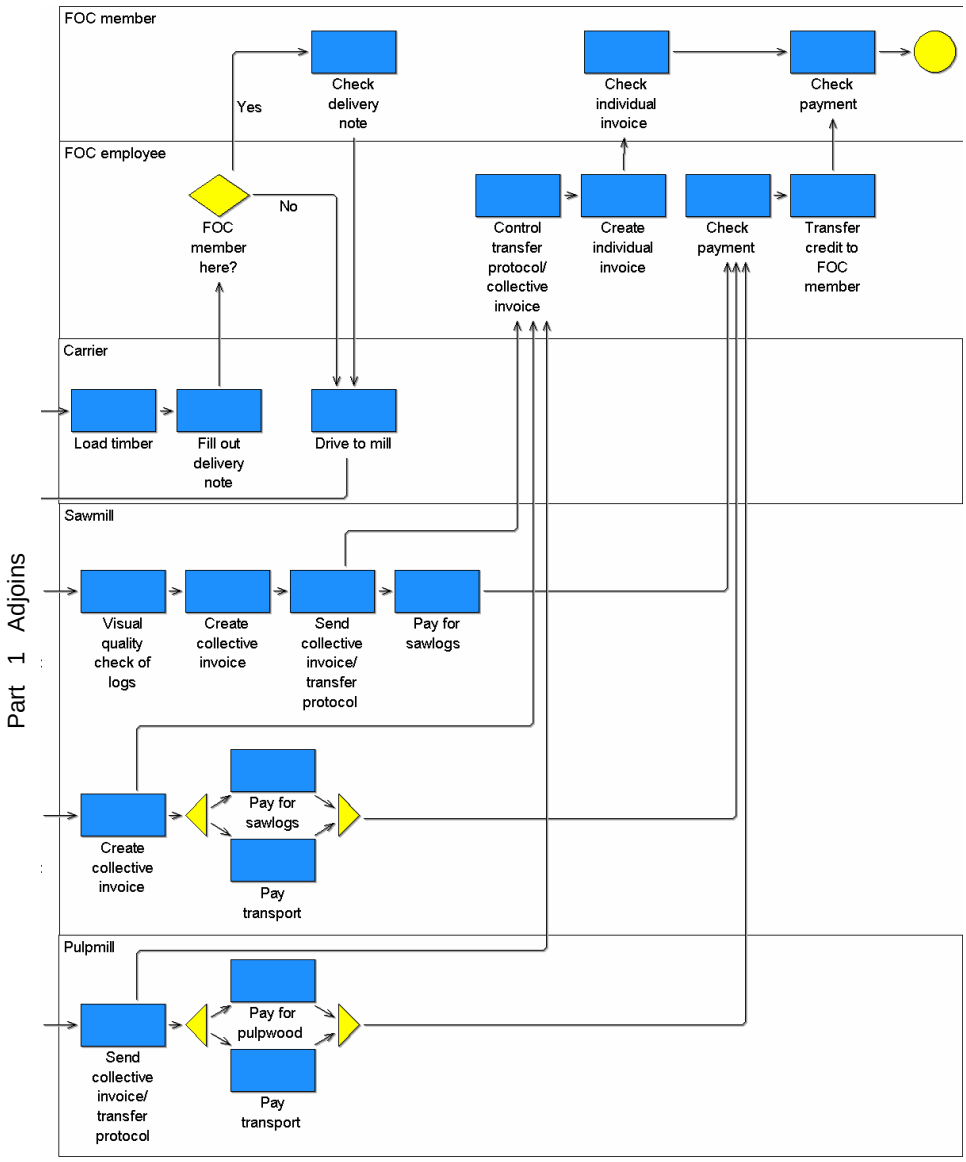

Figure 3. The actual business process model for FOC Leoben (Part 2)

Processes of each process owner (e.g. FOC member or carrier) are drawn in an extra row marked with the owner's name. As illustrated in Figure 2, the typical process chain starts with concluding a framework contract between FOC and mill as first process symbolised by a rectangle (a triangle marks the start of the process chain). Assortments, qualities and prices are fixed for a one-year period. The FOC employee informs FOCs members about harvesting, relevant assortment parameters and prices. The FOC member starts harvesting timber. In the case of FOC Leoben, the member usually clearcuts forest stands with a chainsaw. Full mechanised harvesting and thinning operations are done by entrepreneurs. When logs have been placed alongside a forest road, the FOC member informs the carrier about the

location and quantities of the assortment. The carrier schedules their trucks usually on a weekly basis and instructs their drivers, mostly by cell (mobile) phone. The truck drivers have accurate local and regional knowledge of place. The timber is loaded, a delivery note is completed and then the truck transports the logs to the mill (Figure 3).

At the mill, the truck driver receives an invoice number and submits his delivery note for control purposes. After that, processes differ between sawmills and paper mills. In sawmills, after unloading the timber volume is measured and the quality category of each log is estimated visually, the log price being based on this quality classification. In small sawmills, measurement is done manually. In Austria, pulpwood is paid according to its absolute dry weight. At paper mills the loaded truck is weighed and a timber sample is taken using a chainsaw. After unloading the truck is weighed again and the timber sample is dried in a drying oven and weighed once more. Using all data, the absolute dry weight of the truck load is estimated.

At sawmills and paper mills, monthly data are used for creating collective invoices for the FOC's timber supply. The invoice as well as data on log volume and quality categories (or weight data) are sent to the FOC and checked there. At the FOC, the collective invoice for total timber supply has to be split into individual invoices according to each member's timber supply during the month.

Mills pay the FOC according to the term of payment that was fixed in the framework contract, and finally the FOC transfers credits according to their individual invoice to members after receiving payment from the mill. Checking the payment by the FOC member is the final process in the model (and is represented by a circle as a process end symbol).

Productivity of the Actual FOC Model

In analysing the logistic chain of FOCs, great differences were found in the amount of work-time and effort used. The differences are dependent on the average area of forest owned by the members (Table 2). This finding is illustrated by deriving the following management measures from main basic data: (i) average forest area per FOC member (total forest area of FOC/number of FOC members), (ii) average lot size (total timber quantity sold by FOC/number of individual invoices), and (iii) labour productivity (total timber quantity sold by FOC/total work time spent by FOC employees).

An average lot size of 24 m^3 timber means that FOC members are selling their timber only as full truck loads. In FOC Hartberg Fürstenfeld, a full truckload of timber sold to the processing industry carries the timber of at least two different members, and in the worst case of up to 17 different members. Different prices are paid in Austria for timber of different qualities. The FOC Hartberg Fürstenfeld has to measure volume and estimate the quality category for each log when it is loaded on the truck in order that each member is paid according to supplied timber qualities and quantities. Measurements at the forest site are expensive and nowadays almost all forest enterprises in Austria use the measurements of sawmills or paper mills.

Measurements at forest site as well as extensive consultancy activities needed by the forest owners of FOC Hartberg Fürstenfeld result in low productivity because other FOCs set the minimum timber selling quantity to a full load truck per member and therefore do not need to measure at forest site. Owners of tiny forests cannot

harvest timber each year and they need more assistance by a forester or a forest worker than owners harvesting each year.

Table 2. Management performance measures of four Styrian FOCs

Case study site	Number of FOC members	FOC area (ha)	Average forest area per member (ha)	Average lot size (m^3/invoice)	Average productivity (m^3/hr)
FOC Soboth	23	900	39	24	17[4]
FOC Leoben	228	7,450	33	24	25
FOC Bruck/Mur	265	10,700	40	24	50
FOC Hartberg Fürstenfeld	1,700	17,000	10	12	10

Low productivity of FOC Hartberg Fürstenfeld is also a result of many processes where two or more process owners have to work jointly. Comparing the number of these interactions for the four FOCs shows that there are large differences in the total number of interactions. Table 3 lists the number of interactions between each supply chain group under each of the four Styrian FOC business process models. FOC Hartberg Fürstenfeld needs five more interactions than the other FOCs, mainly because of the support provided to members in silvicultural and harvesting operations. This additional service is a critical factor if the timber utilisation rate in small-scale forests is to be raised, because many forest owners do not have enough knowledge nor practice for harvesting timber independently.

Table 3. Interactions between workers of the supply chains of the four Styrian FOC business process models[a]

Supply chain participant	FOC employee				Forester				External workers				Overall			
	Ha	Br	Le	So	Ha	Br	Le	So	Ha	Br	Le	So	Ha	Br	Le	So
FOC member	3	5	4	4	3	0	0	0	0	3	3	3	6	8	7	7
FOC employee					2	0	0	0	1	3	4	4	3	3	4	4
Forester									7	0	0	0	7	0	0	0
Total number of interactions													16	11	11	11

[a] Ha = Hartberg Fürstenfeld, Br = Bruck/Mur, Le = Leoben, and So = Soboth.

Business Models for Various Types of Small-scale Forest Owners

Empirical evidence shows that when forest size decreases then consultancy efforts increase. With smaller average forest area per member, there is a more than proportional increase in work time for administrating and supporting forest owners

[4] Negative scale effects occur for FOC Soboth because of the small cooperation size and timber quantity sold.

that lack forest management knowledge and practice (Frank 2000, Rauch 2003). Due to the smaller average forest area, increasing consulting services also face smaller wood quantities. The resulting challenge for FOCs is to assist forest owners with tiny annual wood supply to sell timber in a cost-effective way. A broad spectrum of management principles may be observed.

It is necessary and practical to differentiate the term 'small-scale forest owner' according to their differing forest management knowledge and silvicultural and harvesting experience. The rough differentiation of small-scale forest owners into 'professionals' who execute the annually possible harvests in their forest predominantly independently, and 'laymen' who can only manage forest with the help of external consultants, is urgently necessary for the advancement of the idea of FOC. Actual implemented FOC models are only suitable for professionals who have forest management knowledge and experience in harvesting timber on their own. But laymen often need assistance, for example for assortment and quantity estimation in thinning operations as well as consultation services regarding silviculture. Shifting responsibility for say harvesting from a layman owner to a forest worker or FOC or an entrepreneur also results in more professionalism.

Depending on their forest management knowledge and attitudes, a number of alternative cooperation models can be attractive to forest owners who want to sell their wood. Four such models are considered here, namely (i) acting independently, (ii) a member of the Styrian FOC Model (SM), (iii) a member of an Individual Accounting Model (IAM), or (iv) a member of a FOC using the Dividend Model (DM). Table 4 illustrates the responsibility of a forest owner for main processes, according to which cooperation model he fits into.

Table 4. Responsibility for a forest owner under four alternative cooperation models[a]

Responsibility for main processes	Organisational model			
	Independently acting forest owner	Member of SM	Member of IAM	Member of DM
Conclude framework contract	x			
Communicate assortments	x			
Harvest timber	x	x		
Administer supply licences	x	x		
Organise transport	x	x		
Generate FOC's invoice		Mill	Mill	Mill
Generate owner's invoice	Mill	Mill	FOC	

[a] An 'x' indicates that the forest owner is responsible for this process. 'Mill' and 'FOC' indicate that this agency is responsible for the process.

Development of a FOC to a service enterprise which can offer this kind of small-scale forest owner as well as the professional the entire spectrum of forest management services is a way to achieve greater utilisation of small-scale forest resources. An increasing number of forest owners without know-how in forestry would have the possibility of delegating their forest management or at least some

components of it to competent partners. Some possible models with varying degrees of delegation for such development are now sketched.

Member of Styrian business process model (SM)
The responsibilities for the various processes under the Styrian model as adopted by FOC Loeben in Styria have been outlined in detail in the case study above. This is the base case against which other forms of cooperation are evaluated.

The Individual Accounting Model (IAM)
The strategy of this model is mutual forest management from several forest owners, but with revenue and expense accounted separately for each owner. A forester develops harvest and silviculture plans for the next year and each member is asked for acceptance of planned measures in their forest. Harvesting and silvicultural activities are carried out by entrepreneurs who are engaged and supervised by the forester. The advantage of this model is that there is no need for labour-intensive advising of single forest owners, where such advising usually focuses on rather small timber quantities. If timber from two or more forest owners has to be transported in one truck, the log volume has to be measured and quality categories have to be estimated visually in the forest by the forester. This is a time-consuming and hence costly process, which is only needed because of separate accounting for each owner, and is also more prone to mistakes. Such a model is in use by the FOC Fresdorfer Heide in Brandenburg, Germany.

The Dividend Model (DM)
The main difference from the individual accounting model is that here no accounting per parcel takes place. The strategy of this model is to manage members' forests jointly and to account for revenues and expenses jointly. Each member receives a dividend according to their proportion of forest area, although value-orientated reference bases are also possible. Once a year, a general meeting controls the forester's work and approves the work program for the next year. A major advantage of this model is that no timber measurements are needed in the forest. In China such a system that is run as joint-stock forest farm is recognised as effectively solving the problem of forest resources ownership, though difficulties arise in valuation of mountain forest and forest land for fixing dividends (Shenqi and Harrison 2000). A similar model is in use by the FOC Dreetzer Heide and by a part of the FOC Buchenhaus in Brandenburg, Germany. For forestry on the sandy slow-growth soils in Brandenburg, this model provides the possibility of covering at least the expenses of forest ownership that arise mainly because of high state government taxes on forests.

Interaction Cost Reduction
Intra-organisational processes require coordination of different process owners from each organisation involved as well as of their differing computing systems. Sawmills as well as papermills use accounting software to administer wood supply data and to generate invoices. Some FOCs also use software to generate individual invoices for their members but their system is not able to read the digital data supplied by mills (Eberl and Seewald 2002). Interaction of process owners gives rise to additional costs, and therefore process engineering often aims to reduce the extent of

interaction. Furthermore, each interaction is a possible source of errors, for example when information is transferred from one person to another. So modern forest management in small-scale forests requires new models for organisation and processes with as few interactions as possible.

The superiority of the Individual Accounting Model and of the Dividend Model can be shown by a simple process of benchmarking where only the processes performed by members or employees of FOCs are considered. The business process model currently used by FOC Hartberg-Fürstenfeld as a typical exponent for a FOC with mainly laymen members – here also called Styrian Model (SM) – is contrasted with the Individual Accounting Model (IAM) represented by FOC Fresdorfer Heide, and the Dividend Model (DM) represented by FOC Dreetzer Heide. Counting the interactions it can be shown that the last two models require fewer interactions to be performed, which is a main requirement for an effective supply chain (Leinert 1998). The numbers of interactions under each of the three business process models, for each major process owner, are presented in Table 5. The SM needs 16 interactions to execute a business case. In the IAM, 13 interactions are needed and in the DM the number of interactions can be reduced to nine.[5]

Table 5. Interactions between workers of the supply chains of the three business process models

Member group	FOC employee			Forester			External Workers			Overall		
	SM	IAM	DM	SM	IAM	DM	SM	IAM	DM	SM	IAM	DM
FOC member	3	3	3	3	0	0	0	0	0	6	3	3
FOC employee				2	3	3	1	4	2	3	7	5
Forester							7	3	1	7	3	1
Total interactions										16	13	9

In comparison to the IAM, three additional interactions are needed in the SM. The processes causing these interactions are: (1) the forester consults single FOC member to find an appropriate harvesting method and silvicultural strategy; (2) the FOC member informs the forester about finishing harvesting activities; and (3) the forester informs the FOC member about the scheduled wood transport date. These three interactions occur because of desiderative forest management knowledge and practice of the forest owner. Because the forest owner does his own logging under the SM model, he requires consultancy advice from the forester.

The IAM requires the following four more interactions than the DM: (1) the FOC employee announces planned wood harvesting operations; (2) the FOC employee selects an entrepreneur; (3) the FOC employee makes a harvest contract with the selected entrepreneur; and (4) the forester measures log volume when it is picked up by a carrier. The main difference between the two models is that in DM processes 1

[5] A more precise evaluation method would be to compare transactions costs under each of the three business process models. Estimating these costs would however be a major research task. In practice, there exits a strong linkage in the engagement of local authorities, regional chambers of agriculture and FOCs, and individual cost contributions are difficult to recognisable. Further, some of the process owners regard their cost data as 'commercial in confidence.'

to 3 are only done once a year because harvest areas are announced as one package. In the IAM, each single harvest area is announced and accounted separately.

CONCLUSION

Applying business engineering methodology reveals high potential for FOCs to improve the utilisation of small-scale forest resources. Process maps showing the process architecture for top management level and for process owners provide an overview of all business processes and provide a sound starting point for more detailed process analyses. Business process models identified as a result of process analyses show interfaces and interactions between business partners as well as detailed processes of the enterprise under investigation. Comparison of interactions needed for operating a single business case show that analysed actual business process models for FOCs have substantial differences in process efficiency.

The main influence on process efficiency of FOCs is the average forest area. When the average forest area of a FOC is declining, consulting intensity and work time spent by the FOC for a single member is rising while timber quantity harvested per member is decreasing. As the area of forest plots declines, increasing consulting requirements also face smaller wood quantities. So it is useful to differentiate the term small-scale forest owner according to forest management knowledge and experience. Distinguishing small-scale forest owners into those that execute the annually possible harvests in their forest predominantly independently and those that can only manage forest with help of external support, is urgently necessary for further development of the FOC concept and role. Strategies and business models for FOCs have to be adapted according to this differentiation. Suggested business process models for laymen FOCs (the Individual Accounting Model as well as the Dividend Model) show essential interaction cost reductions and seem to offer promise for increasing utilisation of small-scale forest resources. Besides having smart processes, a future challenge for each FOC is to become a forest service enterprise offering small-scale forest owners various types of forest management services.

Suggested business process models for FOCs can be used in most European countries where small-scale forest ownership is a major obstacle to mobilisation of wood resources. The potential further development possibilities of FOCs are of economic importance because FOCs are required for increasing utilisation of timber from small-scale forests to overcome the expected roundwood shortfall in Europe.

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